The threat of East Asian pathogens to Nordic Forests

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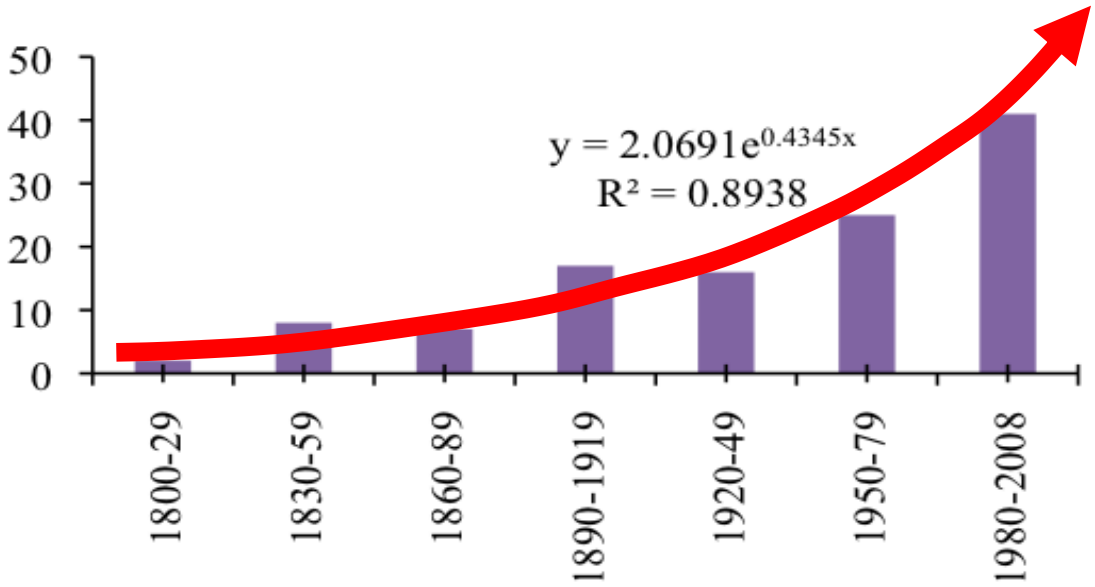
Exponential growth of alien pathogens

- The number of alien pathogens in European countries has grown exponentially during the last 200 years
  - Santini et al.: New Phytologist (2013) 197, 238-250



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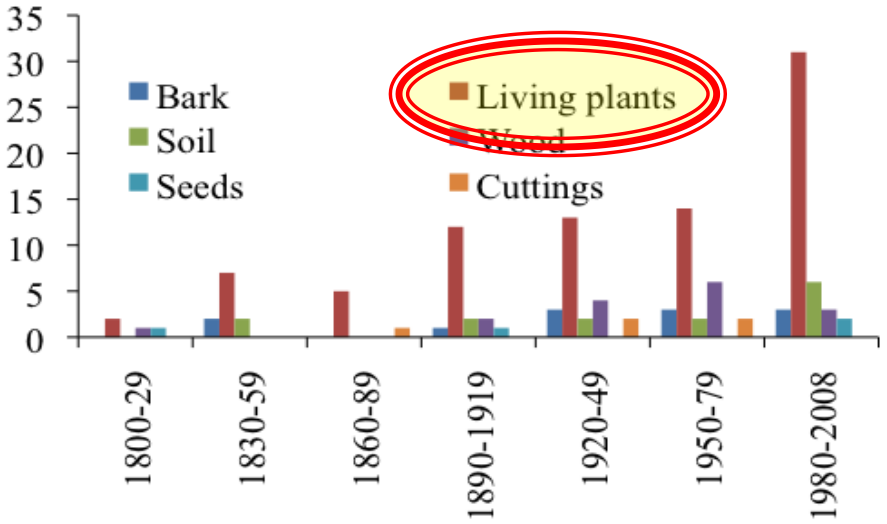
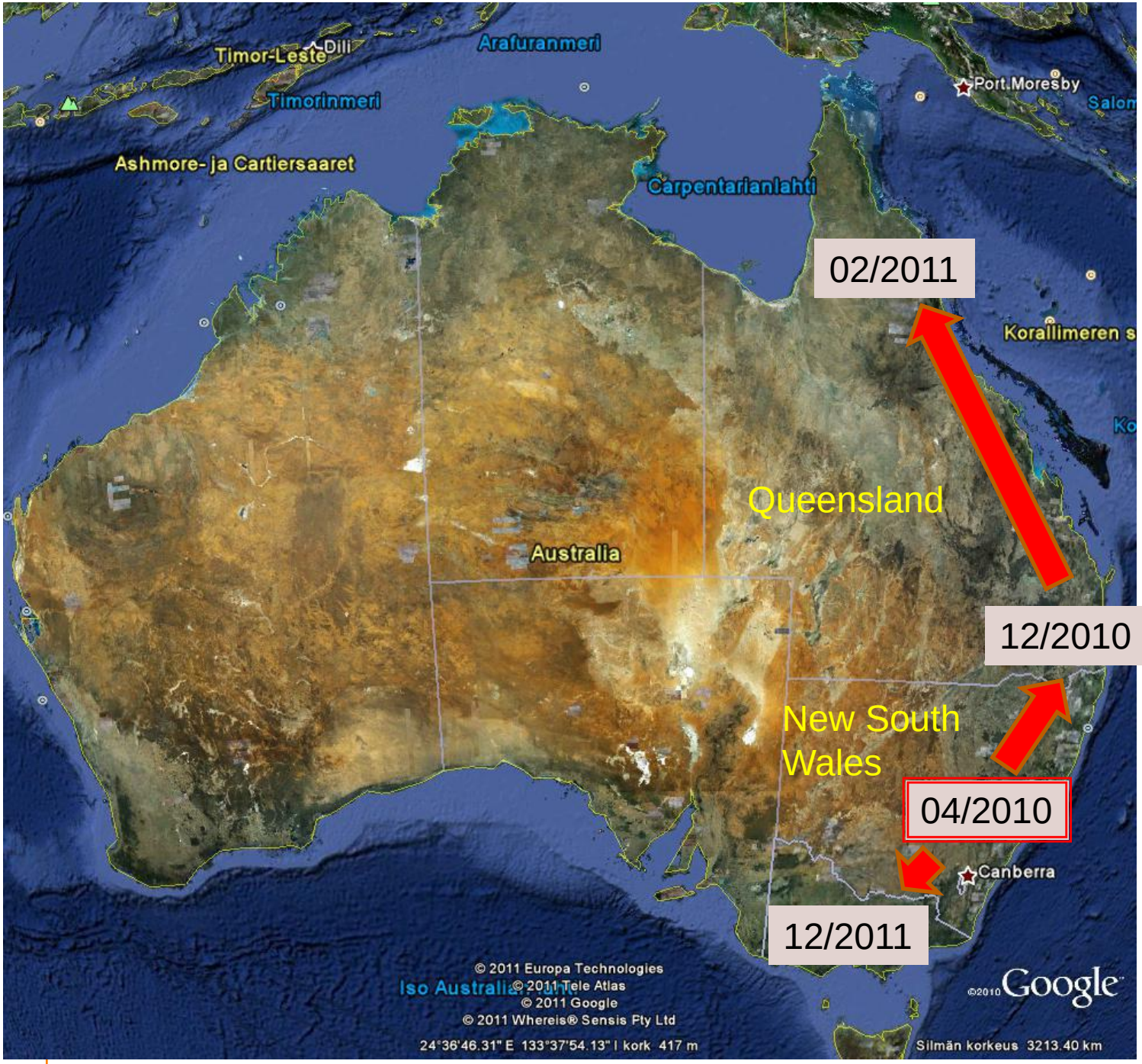
Pathways (Santini et al., 2013)

- The most common pathway for alien pathogens has been the trade of living plants for 200 years
  - above 70% since 1980´s
  - ornamental plants, forest tree seedlings, large urban tree seedlings, bonsai-plants etc...





South America

Florida

Hawaii

Australia

South Africa

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Limitations in the best practices

- Myrtle rust spread to Australia, although
  - the continent is separated from the rest of the world by an Ocean
  - the plant health quarantine in Australia is more stringent than anywhere else in the world
  - the risk caused by the Myrtle rust was well known beforehand
  - eradication actions were planned beforehand and started after the rust was observed

➢ Even the best practices do not quarantee that the spread of pests and pathogens would stop

Reality

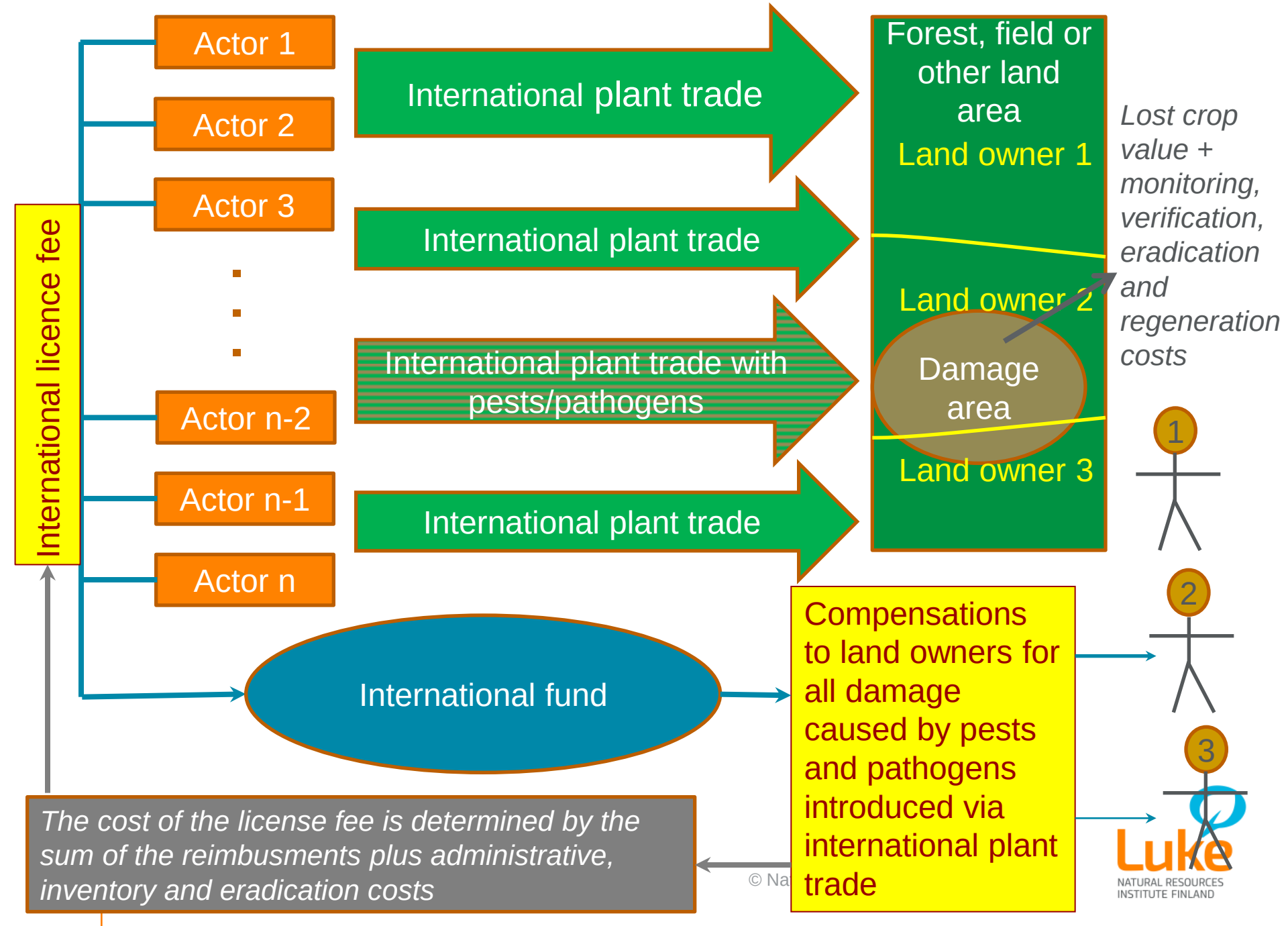
- WTO will most probably strongly oppose any means to restrict the global trade
  - Montesclaros declaration
    - all trade in plants and plant products determined to be of high risk to forested ecosystems but low overall economic benefit should be phased out
  - is not going to be accepted globally in near future

➢ New non-restrictive solutions are needed!

International plant trade licence

- We have suggested an international plant trade licence should be established
- Licence should be obligatory to all actors in the international plant trade
- The licence fee should be used to compensate the damage caused to third parties

➢ The licence would solve the problem of subsidizing risky international trade against safer local production


Actor 1
Actor 2
Actor 3
Actor n-2
Actor n-1
Actor n
International licence fee
International plant trade
International plant trade
International plant trade with pests/pathogens
International plant trade
Forest, field or other land area
Land owner 1
Land owner 2
Land owner 3
Damage area
Lost crop value + monitoring, verification, eradication and regeneration costs
1
2
3
International fund
Compensations to land owners for all damage caused by pests and pathogens introduced via international plant trade
The cost of the license fee is determined by the sum of the reimbusments plus administrative, inventory and eradication costs
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Benefits of the licence

- The true costs would be included in the prices of the imported plants
  - ➢ international plant traders, and ultimately their clients, would pay for the costs caused by the business
  - ➢ shared responsibility would solve the identity and cost problems
  - ➢ business would be motivated to address and minimize the risks caused by plant material in trade
  - ➢ the trade with the least overall economic benefits and highest risks would be eliminated
- Implementation could be possible at any international level

The risks caused by East Asian pathogens to European tree species

- In theory
  - the highest risk is due to pathogens with no evolutionary history with European tree species
  - ➢ so, would this be reflected as an association between the disease risk and geographical distribution range of trees?

Conifers vs. broadleaved thees

- Santini et al. 2013: conifers have less pathogens than broadleaved trees in Europe
- So, is this true also vice versa e.g. have East Asian pathoges attacked a smaller propotion of conifers than broadleaved trees?

Hypotheses

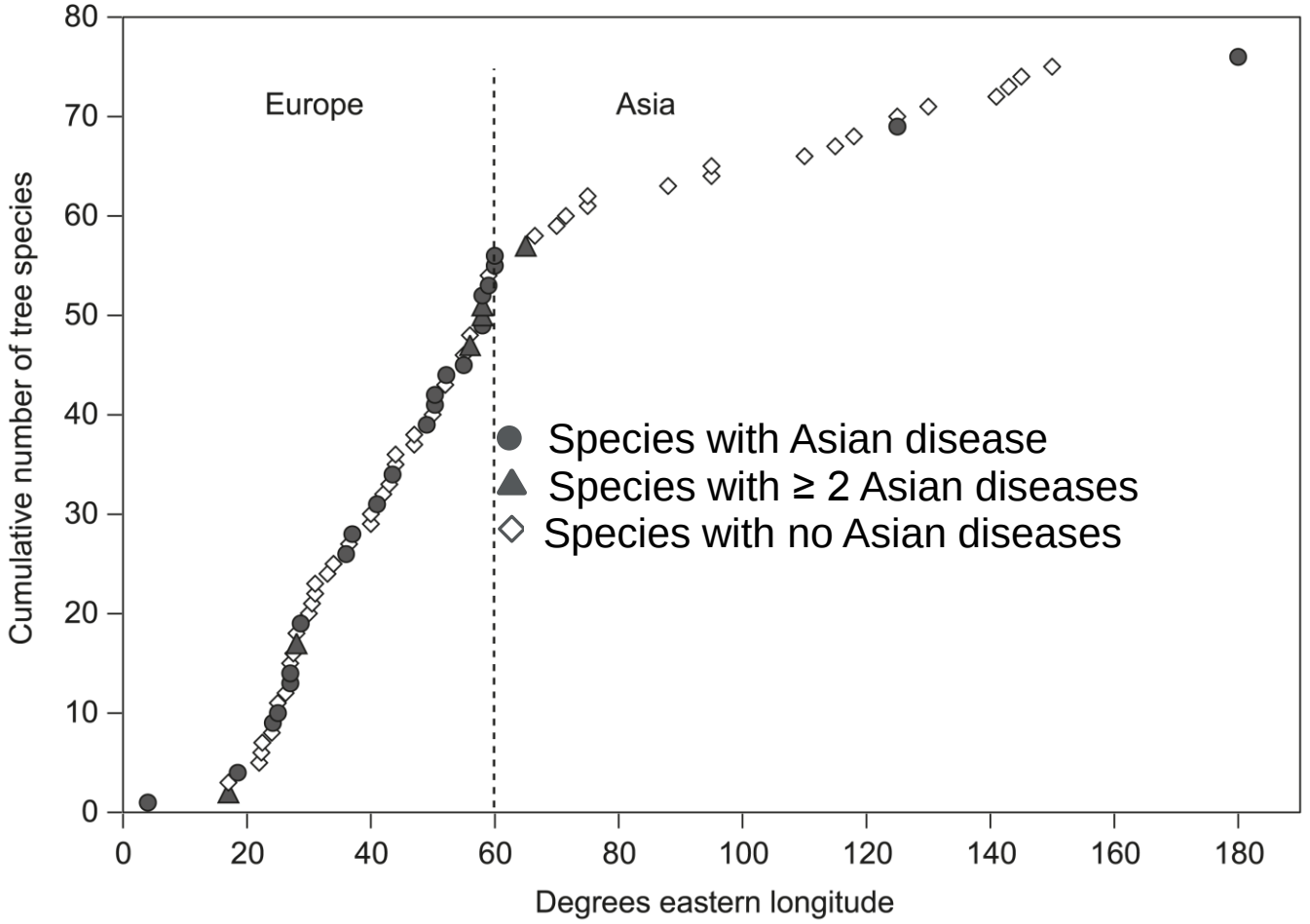
1. Diseases caused by Asian Invasive Forest Pathogens (IFPs) have been more frequent in tree species restricted to Europe than in those with distributional ranges extending to Asia.
2. The conifers in Europe have had less Asian IFPs than broadleaf trees.
3. The proportion of European tree species occurring in Caucasia and having been attacked by Asian IFPs is lower than the proportion of attacked species present elsewhere in Europe but not in Siberia.

Possible routes of IFP transmission from Asia to Europe

Material and Methods

- We updated the Asian IFP-list of Santini et al. 2013 (New Phytologist 197, 238-250)
- Determined their host tree species from literature
- Classified them into two pathogenicity classes: moderate or severe (for each host tree species)
- Determined distribution ranges of 75 European tree species
- 84 observational units composing of 37 host-pathogen combinations and 47 tree species with no IFP
- Disease incidence defined as the number of identified host-pathogen combinations divided by the number of observational units

European tree species as a function of their eastern distribution limit



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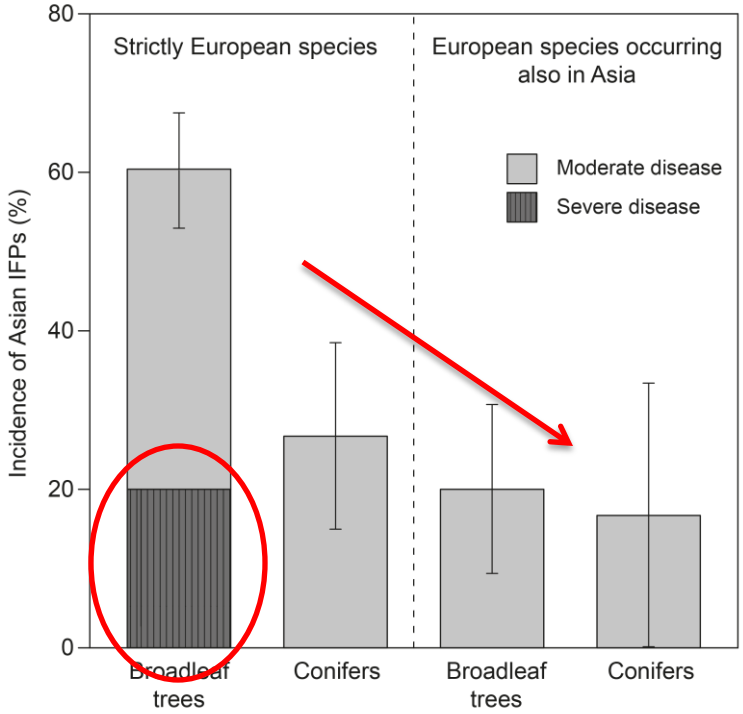
The same trend in both broadleaf and coniferous trees

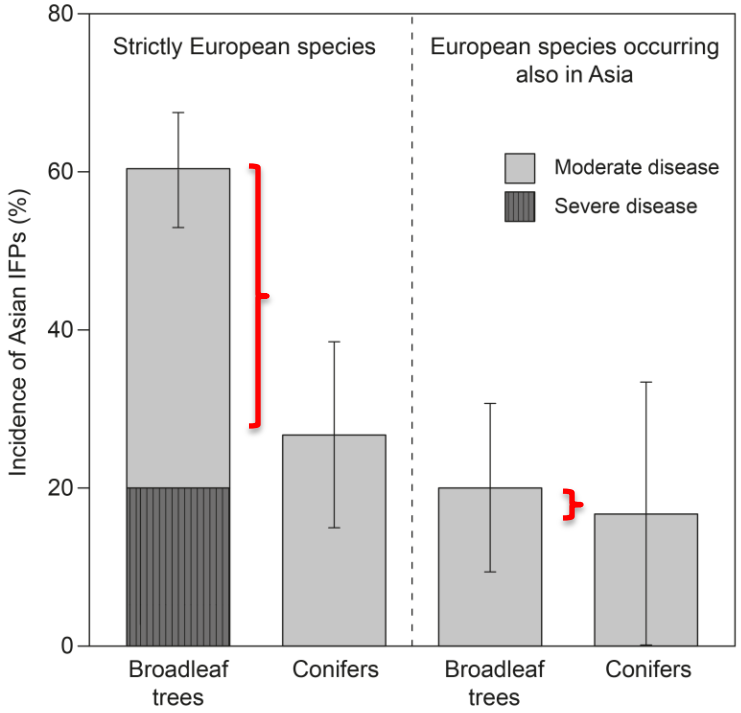


- All serious diseases occur in trees restricted to Europe

➢ Hypothesis #1 is supported

  – the risk of Asian IFPs is higher among species restricted to Europe than those with distribution areas extending to Siberia

The same trend in both broadleaf and coniferous trees



- The number of East Asian diseases was lower in conifers than broadleaf species
- ➢ Hypothesis #2 was supported
  - – the risk of Asian IFPs is higer on conifers than on broadleaved tree species

The southern route

Group of tree species	IFP incidence
Strictly European excluding Caucasia	42 %
European occurring also in Caucasia	62 %

P = 0.115

- Hypothesis #3 is not supported
- The transmission of trees and/or pathogens via the possible southern route to Europe has been uncommon or it has not existed at all

Relief for the Northern forestry?

- Most of the European tree species extending East of Ural have probably had common evolutionary history with the East Asian plant pathogen community
- ➢ The risk of Asian catastrophe in the most important boreal forest trees is probably smaller than that of many other European trees
  - – not necessarily against all East Asian pathogens
  - – definitely not against North American pathogens

Conclusions

- The spread of alien pathogens accelerates exponentially despite the species list based quarantine protocols
- The land owners and tax payers subsidize international plant trade against less risky local production
  - costs of IFPs should be internalized into the plant prices
- The risk caused by Asian IFPs in European forests is highest among deciduous tree species distributed in Europe only (i.e. temperate and Mediterranean forests)
- The risk of Asian IFPs is lowest among coniferous species distributed to East Asia (i.e. boreal forests in Europe)
- Tree and pathogen dispersal via the potential southern route (Caucasia-Iran-Afganistan etc.) during recent history is unlikely

The presentation was based on the following publications:

- Hantula, J., Müller, M.M. & Uusivuori, J. 2014. International plant trade associated risks: laissez-faire or novel solutions. Env. Sci. Pol. 37, 158-160.
- Müller, M.M., Hamberg, L. & Hantula, J. 2016. Susceptibility of European tree species to invasive Asian pathogens. Biol. Invasions, DOI 10.1007/s10530-016-1174-6

Thank you!

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